

Research on the anodizing of...

S/081/62/000/013/024/054  
B177/B101

in films of poor quality. Raising the temperature to not less than  $80^{\circ}\text{C}$  reduces the terminal voltage and makes it possible to get films with better protective properties. The following optimum methods of anodizing Ti are recommended. I. 18 % solution of  $\text{H}_2\text{SO}_4$ ;  $80^{\circ}\text{C}$ ;  $D_a$  0.5 a/dm<sup>2</sup>; time 2-8 hours. II. 18 % solution of  $\text{H}_2\text{SO}_4$ ;  $100^{\circ}\text{C}$ ;  $D_a$  2 a/dm<sup>2</sup>; time 2 hours. ✓

[Abstracter's note: Complete translation.]

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S/137/62/000/006/144/163  
A057/A101

AUTHORS: Matveyeva, T. V., Tyukina, M. N., Pavlova, V. A., Tomashov, N. D.

TITLE: Investigation of the anodic oxidation of titanium in sulfuric acid solutions

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 6, 1962, 97, abstract 6I612 (V sb. "Titan i yego splavy". no. 6, Moscow, AN SSSR, 1961, 211 - 220)

TEXT: Annealed Ti sheets with  $\delta$  14.8% and the following chemical composition were investigated (in %): Fe 0.13, Ni 0.15, Si 0.17, C 0.050, N 0.098, Ca 0.34. The anodizing was carried out in  $H_2SO_4$  solutions. Properties of the coatings were investigated in dependence on the conditions of anodizing: the concentration and temperature of the acid, the duration of anodizing, and  $D_a$ . The anodic oxidation of Ti proceeds in  $H_2SO_4$  solutions at room temperature at high voltage at the terminals, therefore coatings of low quality are obtained. An increase of the temperature of the acid, especially to 80°C and more, decreases the voltage on the terminals yielding thus coatings with better protective properties. The following optimum conditions of anodizing are presented: 1) 18%  $H_2SO_4$

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solution, temperature 80°C,  $D_a$  0.5 a/dm<sup>2</sup>, duration of anodic oxidation 2 - 8 hrs;  
2) 18% H<sub>2</sub>SO<sub>4</sub> solution, temperature 100°C,  $D_a$  2 a/dm<sup>2</sup>, duration of anodic oxidation 2 hrs. There are 14 references.

Ye. Layner

[Abstracter's note: Complete translation]

Card 2/2

TOMASOV, N. D., prof., a kémiai tudományok doktora

Electrochemical theory of the corrosion of metals. Muszaki kozl MTA 19  
no.1/4:65-83 '61.

1. Fizikai-Kémiai Intezet, Moszkva.

TOMASHOV, N.D., doktor khimicheskikh nauk

Development of the electrochemical theory of metal corrosion. Acta  
techn Hung 32 no.1/2:163-183 '61. (EEAI 10:5)

(Corrosion and anticorrosion) (Electrochemistry)

10.15

S/080/61/034/008/012/018  
b204/b305

11800

AUTHORS: Tomashov, N.D. and Zalikov, F.P.  
TITLE: The influence of the structure of thick anodically oxidized films on their properties  
PERIODICAL: Zhurnal prikladnoy khimii, v. 34, no. 8, 1961, 1799-1807

TEXT: The investigation covered the dependence of certain properties of anodically oxidized films, produced by the hard anodizing method as developed by the Institut fizicheskoy khimii (Institute of Physical Chemistry) of USSR, on their structure. Specimens of 99.99% pure aluminum, as well as of a number of binary aluminum alloys, specially cast and heat treated by homogenization and subsequent water quenching, were used. Duralumin D16ABTV (3.8 - 4.9% Cu, 1.2 - 1.8% Mg, 0.3 - 0.9% Mn, 0.5% Si, 0.5% Fe, remainder Al) was also studied. Anodic oxidation was carried out in a 4 N H<sub>2</sub>SO<sub>4</sub> solution at a temperature of -20° and anode current densities of 2.5, 5 and 10 A/dm<sup>2</sup>. The formation voltage corresponding to these curr-

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ent densities was 22 - 27 V for aluminum and 25 - 35 V for aluminum alloys (the formation voltage is the voltage across the cathode and the anode of the bath at the time when the porous part of the film above the barrier layer begins to grow). Comparison between the structure of the anodic film forming in the normal anodizing process ( $i_{Ca} = 1 \text{ A/dm}^2$ , formation voltage - 10 V,  $t = 20^\circ$ ) was also made. Dissipation of the intense heat emitted during anodizing was carried out by means of internal cooling, in which heat was conducted away by supplementary cooling of the anodized component, or else by means of circulation of the electrolyte itself. In individual cases, simple mechanical stirring of the electrolyte was sufficient. The total porosity of the anodic films was determined by saturating the films with mineral oil at  $95^\circ$ . Hardness measurements were carried out by means of a PMT-3 machine, using a load of 20 g on the diamond pyramid. The wear resistance of the anodic coatings was studied with a Shkoda-Savina machine fitted with a revolving disc made of the superhard "Vidia" alloy, in a jet of 0.5%  $\text{K}_2\text{CrO}_4$  solution. The microstructure of the anodically oxidized films was examined through

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EM-3 and EUM-100 electron microscopes. Negatives of  $8 - 12 \times 10^3$  magnifications were obtained. The metallurgical microscope MM-6 was used for the macrostructure. The following relationships were studied: porosity (volume %) against current density; microhardness and regular porosity against current density; wear and number of oxide cells and pores per  $1 \text{ mm}^2$  against current density; and relative wear resistance against the alloy element content (Zn, Mg, Al, Cu, Mn, etc.). The dependence of the corrosion resistance properties on the depth of the thin impervious barrier layer and the structure of the porous anodic film produced under various conditions of anodizing were also noted. It was found that the structure of anodic films contains apart from the normal micropores which constitute the regular porosity, certain macro and microcracks, as well as macrovoids, which make up the so-called irregular porosity. Relationships were revealed between hardness, frictional wear resistance and corrosion resistance of thick anodically oxidized films on the one hand and their structure on the other. It was shown that the hardness and wear resistance of anodic films produced on pure aluminum depends essentially on their regular porosity. The hardness

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0204/0305

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of anodic films produced on aluminum alloys with high copper content (4 - 8% Cu) depends mainly on the irregular porosity. The high wear resistance of anodic films produced on a number of heterogeneous binary aluminum alloys is due to the presence in the film of crystals of intermetallic compounds ( $\text{FeAl}_3$ ,  $\text{MnAl}_6$ ,  $\text{CuAl}_2$ ), as well as crystals of Si. The lower wear resistance of anodic films produced on homogeneous alloys is due to the greater total porosity of these films. The corrosion resistance of anodic films produced on pure aluminum depends on two factors: the thickness of the barrier layer and the number of pores in the films. With an increase in current density, films form which possess higher corrosion resistance properties; this is associated with an increase in the thickness of the barrier layer and a decrease in the regular porosity. There are 9 figures, 2 tables and 11 references: 10 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English-language publication reads as follows: F. Keller, M. Hunter, D. Robinson, J. Electrochem. Soc., 100, 9, 411 (1953).

ASSOCIATION. Institut fizicheskoy khimii AN SSSR (Institute of

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The influence of the structure...

S/080/61/034/008/012/018  
D204/D305

Physical Chemistry. (M. USSR)

SUBMITTED: December 31, 1960

Card 5/5

S/076/61/035/002/009/015  
B124/B201

AUTHORS: Tomashov, N. D., Mikhaylovskiy, Yu. N., and Leonov, V. V.

TITLE: Mechanism of the electrochemical corrosion of metals under insulation coatings. I. Kinetics of the destruction of insulation coatings on metals in electrolytes

PERIODICAL: Zhurnal fizicheskoy khimii, v. 35, no. 2, 1961, 367-372

TEXT: A study has been made of the electrochemical behavior of metal electrodes insulated by means of thin bitumen-, paraffin-, bakelite-, and other coatings. The electrodes were Pt, Cu, and Fe wires, 0.5 to 1 mm in diameter. The film was applied by dipping the electrode into liquid insulating material and then slowly and uniformly extracting it by a Warren motor. The thickness of the resulting film was determined by the extraction rate of the electrode and the viscosity of the insulating material. The capacity method was applied for measuring the film thickness; it amounted to 1 - 4  $\mu$ . The kinetics of the destruction of the insulation film on metals in electrolytes was measured with the aid of the capacity and the resistance of the insulated electrode in a 0.5 N

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NaCl solution; the measuring device is diagrammatically shown in Fig. 1. After electrode 1 was insulated, it was dipped into glass cell 2 filled with the electrolyte. Capacity and resistance were measured with a cylindrical auxiliary Pt electrode 3. The measurement was made with the equal-armed bridge 5 which was fed by generator 4 of the type 3Г2А (3G2A). The a-c amplitude did not exceed 20-25 mv. The bridge equilibrium was visually fixed with the oscilloscope 7 of the type 30-4 (EO-4), the amplifier 6 being connected to its input. Capacity and resistance were measured at determined time intervals after the electrode was dipped into the electrolyte. The tests were conducted at room temperature (20-22°C) within a maximum of 30 days. Fig. 2, a shows the curves of the change of capacity and resistance with time on a bitumen-film covered Pt electrode in 0.5 N NaCl. The capacity of the electrode rises and its resistance drops with time, which is correlated with the change of the film structure upon the action of the electrolyte. The authors theoretically infer from the measurement results that the deterioration of the insulation characteristics of coatings such as bitumen and the beginning of the corrosion process are chiefly connected with the penetration of the electrolyte into the micropores and defects of the film as far as near the metal surface.

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face, while the swelling of the film takes longer and is of no great importance. Fig. 2,6 shows that RC remains constant during a 30-day test of the Pt electrode under bitumen coatings. Fig. 3, a shows the dependence of the Pt electrode capacity under a bitumen coating on the initial frequency during 15 to 30 days. Fig. 3,6 shows the same in logarithmic coordinates. The curves of the change of capacity on Fe and Cu insulated with a thin bitumen film are given in Fig. 4. A decisive factor determining the initial rate of destruction of the insulation film is the electrochemical nature of the metal. G. V. Akimov and N. D. Tomashov are mentioned. There are 4 figures and 10 references: 7 Soviet-bloc and 3 non-Soviet-bloc. The two references to English language publications read as follows: C. Corfield, Gas., 21, 11, 35, 1945; E. A. Koenig, Oil, a.Gas J., 44, 20, 303, 1945.

ASSOCIATION: Akademiya nauk SSSR, Institut fizicheskoy khimii  
(Academy of Sciences USSR, Institute of Physical Chemistry)

SUBMITTED: June 2, 1959

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4016, 1138, 1208

S/076/61/035/003/010/023  
B121/B203

AUTHORS: Tomashov, N. D., Mikhaylovskiy, Yu. N., and Leonov, V. V.  
TITLE: Mechanism of electrochemical corrosion of metals under insulation coatings. II. Kinetics of cathodic processes during the corrosion of metals under insulation coatings

PERIODICAL: Zhurnal fizicheskoy khimii, v. 35, no. 3, 1961, 588-594

TEXT: The authors studied the cathodic processes on metals (Pt, Cu, Fe) whose surface was coated with thin layers (1-6  $\mu$ ) of an insulating film (bitumen, Bakelite, and nitrocellulose lacquers) in solutions of corrosive properties. They studied the cathodic polarization and the change in capacity of insulated and noninsulated platinum electrodes in a solution of 0.1 N  $\text{Fe}^{2+}$  + 0.1 N  $\text{Fe}^{3+}$ , and observed an intense polarization at the insulated electrode, even at low cathode current density. The occurrence of electron conductivity in individual parts of the insulating film of platinum is explained with the electron conductivity in the film itself. A gradual increase of the electrochemically active metal surface occurs during the cathodic polarization, which facilitates the electrochemical process. During

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the electrolytic process, the layer round the electrode is in an active state promoting the cathodic process. Therefore, cathodic processes may also occur in the thinnest spots of the insulating film. The mechanism of metal corrosion under porous insulating materials was discussed. The cathodic process was assumed to take place not only on the bare metal surface but also in the finest sections of the insulating film. Macro- and microcorrosion pairs occur on the metal surface insulated with a fine porous insulating film, the free metal surface acting as anode, and the insulated part as cathode. The density of the corrosion current does not only depend on the electrochemical nature of the electrode metal but also on the electric properties of the insulating material. The authors thank A. A. Novikov for assisting in the experiments. There are 5 figures and 13 references: 12 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English-language publication reads as follows: Yasushi Soto, Masuo Kamioka, Yuhei Nemoto, J. Elektrochem. Soc. Japan, 26, 1, E-26, 1958.

ASSOCIATION: Institut fizicheskoy khimii Akademiyi nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

SUBMITTED: July 3, 1959

Card 2/2

16.8300

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S/076/61/035/004/002/018  
B106/B201

AUTHORS: Tomashov, N.D., Mikhaylovskiy, Yu.N., and Leonov, V.V.

TITLE: Mechanism of the electrochemical corrosion of metals  
under insulating coatings

PERIODICAL: Zhurnal fizicheskoy khimii, v. 35, no. 4, 1961, 736 - 742

TEXT: III. Study of the mode of operation of macrocorrosion pairs  
forming with partial insulation of a metal surface by thin protective films

In continuation of earlier studies on the corrosion processes in metals protected by insulating coatings (Ref. 1: Zh. fiz. khimii, 3, 400, 1960; Ref. 2: Zh. fiz. khimii, 35, 367, 1961), the authors conducted a systematic investigation of the mode of operation of the macrocorrosion pair formed from an insulated and the corresponding noninsulated metal in an electrolyte solution. The specimens were prepared from wire electrodes 1 mm in diameter and 50 mm in length, made of copper, iron, aluminum, and zinc. The insulation materials used were bitumen, paraffin, bakelite lacquer, nitrocellulose, varnish, zinc white on varnish, and  $Fe_2O_3$  on

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varnish; the coatings were between 1 and 6  $\mu$  thick. The method of applying the coatings has already been described in the abovementioned papers. The electrolyte solution was 0.5 N NaCl + 0.016 N  $H_2O_2$  + 0.01 N HCl. The experiments were made at room temperature and took up to 48 hours. It was found that an insulated iron electrode always behaved as a cathode as compared to a noninsulated iron electrode, regardless of the nature of the insulation material. The maximum density of the corrosion current with iron electrodes was in most cases attained 12-15 hours after the beginning of the experiments. With equal thickness of the coating, the macrocorrosion current on an electrode with a bitumen coating was found to be 5 times as strong as on an electrode coated with varnish. The addition of pigmenting substances (excepting zinc white) to nitrocellulose and varnish effects an increase of the density of the maximum corrosion current. Similar conditions arise also in insulated zinc and aluminum electrodes. The initial capacity of insulated electrodes rises in the electrolyte solution by 2-3 orders of magnitude in the course of 48 hours, while the resistance drops to about the same extent. Such phenomena do not appear on noninsulated electrodes. The electrochemical nature of the

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electrode metal has an effect upon the corrosion current of the macro-corrosion pair. For the same insulation material ( $\text{Fe}_2\text{O}_3$  on varnish), the density of the maximum corrosion current grows in the succession copper < aluminum < iron < zinc, i.e., with dropping corrosion stability of the metal in the electrolyte solution. The mechanism of corrosion under the insulating coating was also studied. A porous insulating coating on the metal surface caused the steady electrode potential to turn more positive, and corrosion to be strongly concentrated in the pores and defects of the coatings. The results of the present work show that, regardless of the nature of the insulation material, the rate of destruction of thin porous insulating coatings is in the first place dependent upon the electrochemical nature of the electrode metal and of the corrosive medium. The coating will retain its insulating properties to a degree proportional to the stability of the metal in the respective electrolyte solution. This result is of a great practical importance. N.I. Zhuravleva is thanked for her active assistance in the experimental work. The authors intend to make a special study of diffusion phenomena on insulated electrodes. There are 6 figures, 2 tables, and 4 Soviet-bloc references.

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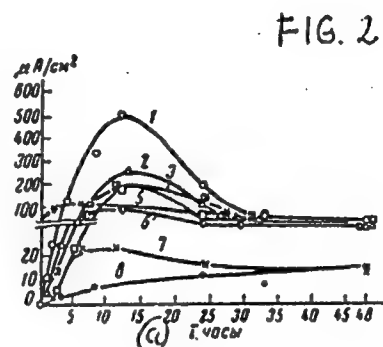
Mechanism of the electrochemical ...

ASSOCIATION: Akademiya nauk SSSR Institut fizicheskoy khimii  
(Academy of Sciences USSR Institute of Physical Chemistry)

SUBMITTED: July 13, 1959

Fig. 2: Change of macrocorrosion current with time in vapors formed from noninsulated and insulated iron electrodes in the solution of 0.5 n NaCl + 0.016 n  $H_2O_2$  + 0.01 n HCl. The insulated electrode is coated: (1) by bitumen; (2) by nitrocellulose with  $Cr_2O_3$ ; (3) by bakelite lacquer; (4) by minium and oil-varnish; (5) paraffin; (6) oil-varnish; (7) zinc white and oil-varnish; (8) nitrocellulose; a) hr

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B106/B201

18.7400

also 1045, 1208, 10 87

AUTHORS:

Zalivalov, F. P., Tyukina, M. N., and Tomashov, P. D.

TITLE:

Effect of conditions of electrolysis upon the formation and growth of anodic oxide coatings on aluminum

PERIODICAL: Zhurnal fizicheskoy khimii, v. 35, no. 4, 1961, 879 - 886

TEXT: A study has been made of the microstructure of anodic oxide coatings on aluminum with the aid of an 3M-3 (EM-3) electron microscope. The coatings were obtained in sulphuric medium by the method of hard anodizing. This special procedure, which has been developed at the authors' institute (Ref. 4: N. D. Tomashov, Vostn. inzh. i tekhn., no. 2, 59, 1946; Ref. 5: N. D. Tomashov, M. N. Tyukina, Issledovaniya po korrozii metallov (Tr. In-ta fiz. khimii AN SSSR) vyp. II, No. 1, Izd-vo AN SSSR, M., 1951), ensures an efficient protection of the surface of aluminum alloys not only from corrosion, but also from wear by friction and other erosive actions. The coatings are thermally stable, and provide an insulation against heat and electric current. A 3M-3 (UEM-3) electron

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microscope was also used for certain examinations. The pictures were obtained in enlargements of 8000 to 12000. A maximum 60000-fold enlargement was obtained by further photographic enlargement. The specimens consisted of AB 000 (AV000) aluminum (99.99% Al) and were 15\*15\*2 mm in size. Prior to anodizing, the specimens were ground, polished with a fine aluminum oxide suspension, and degreased. The anodic oxidation took place in 4 N sulfuric acid at 0.5°C and at current densities of 25, 50, and 100 ma/cm<sup>2</sup>, or initial voltages of 22, 25, and 27 v. The duration of oxidation was varied between a few seconds and 120 minutes. The microstructures of very thin and very thick coatings could thus be intercompared. During oxidation the electrolyte was vigorously intermixed in order to obtain more homogeneous coatings. The diameter of the pores of the coatings that were obtained was determined with the electron microscope. The number of pores per unit area of coating was established from the quantity of oxide cells per unit area. The very thin coatings ( $\delta = 0.05-0.08\mu$ ) obtained in the initial stage of anodic oxidation were examined directly in the electron microscope after being detached from the aluminum surface in a sublimate solution. A copy was prepared of the thick coatings ( $\delta = 50-100\mu$ ) resulting from longer anodizing under the

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same conditions. For this purpose, a very thin layer of collodion or quartz was applied to the surface of oxidized aluminum, which took up the relief of the oxide coating concerned. This copy was studied in the electron microscope. Results: The coatings submitted to investigation are no dense oxide layers irregularly traversed by channel-shaped pores, but constitute dense packings of cells in the form of hexagonal prisms resting normally to the metal surface, and connected to one another at the side faces. These results were compared with the structures of coatings obtained under usual conditions of anodic oxidation in sulfuric acid. For this purpose, aluminum specimens were anodically oxidized at 20°C and a current density of 10 ma/cm<sup>2</sup>, and an initial voltage of 10 v. The mean diameter of the pores in the coatings was found to be independent of the method of anodizing in sulfuric acid, and to amount to 120 Å. It was established on the other hand that coatings produced by the above described method of hard anodizing exhibit basically new properties. They display a great hardness and stability against wear by friction. These improved properties are based upon an enlargement of oxide cell dimensions (by a thickening of the walls) and upon the reduction of the number of pores per unit area of the coating. The scientific workers of the

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Effect of conditions of . . .

laboratory for sorption processes at the authors' institute are thanked for their assistance, V. M. Luk'yanovich and Ye. A. Leont'yev for valuable advice. There are 8 figures, 1 table, and 10 references: 7 Soviet-bloc and 3 non-Soviet-bloc. The reference to the English language publication reads as follows: F. Keller, M. S. Hunter, D. Z. Robinson, J. Electrochem. Soc., 100, 411, 1953.

ASSOCIATION: Akademiya nauk SSSR Institut fizicheskoy khimii  
(Academy of Sciences USSR Institute of Physical Chemistry).

SUBMITTED: July 24, 1959

Card 4/5

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24021  
S/076/61/035/005/004/008  
B101/B218

AUTHORS: Tomashov, N. D., Chernova, G. P., and Al'tovskiy, R. M. (Moscow)

TITLE: Study of the mechanism of electrochemical corrosion of titanium. III. Corrosion and electrochemical behavior of titanium and titanium alloys with platinum and palladium in solutions of sulfuric and hydrochloric acid

PERIODICAL: Zhurnal fizicheskoy khimii, v. 35, no. 5, 1961, 1068-1077

TEXT: The corrosion resistance of titanium to high acid concentrations and temperatures above room temperature was improved by alloying with Pt or Pd. The following alloys were made of titanium of the type BT-1 (VT-1), alloyed in a vacuum high-frequency furnace: no. 1: Ti+1% Pt; no. 2: Ti+2% Pt; no. 3: Ti+1% Pd; no. 4: Ti+2% Pd; and no. 5: pure Ti (remelted VT-1). The electrochemical characteristics of these samples were studied by recording the potentiostatic polarization curves with an electrochemical potentiostat. Fig. 1 shows the results obtained from 40% H<sub>2</sub>SO<sub>4</sub> for Ti and Ti+1% Pt with the characteristic points E<sub>CT</sub> = steady potential; E<sub>π</sub> = passivation potential corresponding to the passivation current I<sub>π</sub>;  
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S/G76/61/035/005/004/002

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Study of the mechanism of electrochemical corrosion of alloys

$E_{\text{pp}}$  = potential of complete passivation, corresponding to the current  $I_{\text{nc}}$  of the passive state;  $E_a$  = activation potential;  $I_c$  is the cathodic, and  $I_a$  the anodic current;  $E_H$  = potential of the hydrogen electrode. The other alloys showed similar results. Fig. 2 presents those obtained from 40, 60, and 70 %  $\text{H}_2\text{SO}_4$ . As may be seen from Fig. 4, there are no corrosion maxima with Ti, but only one with the alloys. Anodic polarization in HCl showed the same behavior as in  $\text{H}_2\text{SO}_4$ . With Ti in 20 % HCl (Fig. 6), however, a cathodic passivity occurred due to the formation of a protective layer of titanium hydride. The results are as follows: 1) Titanium alloys containing Pt and Pd are much more resistant to corrosion than pure Ti. 2) Increased temperature and acid concentration complicates the passivation of Ti because the potential is shifted in the direction of positive values. 3) In alloys of Ti containing Pt and Pd, the steady potential becomes more positive due to a reduction of the hydrogen overvoltage by 350-400 mv and, thus, lies within the range where Ti is completely or almost completely passivated. This fact leads to an increase in the corrosion resistance of these alloys. There are 7 figures, 2 tables, and 11 references: 5 Soviet-bloc and 6 non-Soviet-bloc. The 2 most important references to English-

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Study of the mechanism of electrochemical...

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language publications read as follows: J. B. Cotton, Chemistry and Industry, no. 3, 68, 1958; L. B. Golden, I. R. Lane, W. L. Acherman, Industr. and Engng. Chem., 44, 1930, 1952.

ASSOCIATION: Akademiya nauk SSSR, Institut fizicheskoy khimii (Academy of Sciences, USSR, Institute of Physical Chemistry)

SUBMITTED: August 3, 1959

Fig. 1: Potentiostatic curves of anodic polarization of Ti and Ti+1 % Pt in 40 %  $H_2SO_4$  at 25 and 50°C. Legend: a) schematic anodic potentiostatic curve (explanation in the text); 5) cathodic curves: 1) Ti in 40 %  $H_2SO_4$  at 25°C and with increasing I; 2) idem with decreasing I; 3) Ti at 50°C; 4) Ti+1 % Pt at 25°C; 5) idem at 50°C; anodic curves: 6) Ti at 25°C and with increasing I; 7) idem with decreasing I; 8) Ti at 50°C; 9) Ti+1 % Pt at 25°C; 10) idem at 50°C.

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1143, 1043, 1151, 1150

21501

S/020/61/137/004/026/031

B101/B208

AUTHORS: Paleolog, Ye.N., Fedotova, A.Z., and Tomashov, N.D.

TITLE: Kinetics of electroodic processes and the mechanism of spontaneous dissolution of n-type and p-type germanium of different resistivity

PERIODICAL: Doklady Akademii nauk SSSR, v. 137, no. 4, 1961, 900 - 903

TEXT: The present paper was intended to solve the following problem: In spite of equal chemical composition and equal surface condition, hydrogen liberation and reduction of  $H_2O_2$  takes place more slowly with p-type germanium than with n-type Ge. On the basis of the general concepts of semiconductor physics, the authors proceeded from the assumption that prevalently electrons of the valency band participate in the cathodic reduction of  $H_2O_2$  in the case of p-type Ge. With increasing resistivity of p-type Ge (reduction of hole concentration), the rate of this process decreases owing to impoverishment of the surface in holes. The change in the rate of the cathodic process in p-type Ge as a function of its resistivity would thus

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Kinetics of electrodic processes ...

be an indirect proof of this assumption. Cathodic polarization and rate of spontaneous dissolution of the following Ge specimens have now been measured:

	n-type Ge	p-type Ge
resistivity $\rho$ , ohm.cm	1.0; 10.0; 20.0	1.3; 12.0; 20.0
diffusion length L, mm	0.5; 1.3; 1.5	0.4; 1.0; 1.5
$\rho/L$	2.0; 7.7; 13.3	3.2; 12.0; 13.3

The experiments were carried out in  $H_2SO_4$  (pH = 1.0);  $H_2SO_4$  (pH 1.0) + 0.2 N  $H_2O_2$ ; and 0.5 N  $Na_2SO_4$  + 0.05 N  $K_3Fe(CN)_6$ . The method has already been described by the authors (Ref. 1: ZhFKh, 34, no. 4 (1960)). The results obtained from  $H_2SO_4$  are given in Fig. 1, and those from  $H_2SO_4 + H_2O_2$  in Fig. 2. The reaction of  $[Fe(CN)_6]^{3-}$  was not inhibited in the case of p-type Ge. Inhibition of the reaction with  $H_2SO_4$  and  $H_2SO_4 + H_2O_2$  increased with increasing  $\rho$  of p-type Ge. The curves show no section that would correspond to the limiting current of free electrons. This confirmed the

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B104/B208

Kinetics of electrodic processes ...

assumption that the majority carriers in n-type Ge consist of free electrons, in p-type Ge, however, of electrons of the valency band. Hardly any impoverishment in holes occurred on the surface of p-type Ge, owing to the positive reduction potential of this ion. The rate of spontaneous dissolution in  $H_2SO_4$  (pH 1.0) + 0.2 N  $H_2O_2$  did not depend on the type of conductivity and  $\varphi$ , and was between 0.87 - 0.98 mg/cm<sup>2</sup>.hr. This is explained by the fact that the surface of both types of Ge in this solution is positively charged at a steady potential, and hole concentration is thus increased. The rate of spontaneous dissolution is here determined by the cathodic process of n-type Ge and the anodic process of p-type Ge. The values calculated from the polarization diagram for the steady potential and the rate of spontaneous dissolution were in good agreement with experimental data. There are 3 figures and 7 references: 4 Soviet-bloc and 3 non-Soviet-bloc. The 2 references to English language publications read as follows: W. Brattain, G. Garrett, Bell System Techn. J., 34, no. 1, (1955); J.B. Flynn, J. Electrochem. Soc., 105, 715, (1958).

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

Card 3/6

21501

S/020/61/137/004/026/031  
B107/B208

Kinetics of electrode processes ...

PRESENTED: November 18, 1960 by A.N. Frumkin, Academician

SUBMITTED: November 10, 1960

Card 4/6

S/020/61/141/004/014/019  
B101/B110

AUTHORS: Tomashov, N. D., Al'tovskiy, R. M., and Kushnerev, M. Ya.

TITLE: Examination of structure of passive oxide films on the  
surface of titanium

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 141, no. 4, 1961, 913 - 916

TEXT: The authors studied composition and structure of passivating films forming in auto-passivation of Ti in various solutions and in anodic passivation. Reference is made to a previous paper (Zav. lab., no. 3 (1960)). Here, the oxide film forming on oxidizing in air on titanium and its alloys BT-5 (VT-5), BT3 (VTZ), and BT3-1 (VTZ-1) was found to consist of TiO. In this case, the oxide film was loosened from the metal base by means of a 5% Br solution in anhydrous methanol, and electronographically analyzed by "transmission". In the present study, the same method was used. Composition and structure of films forming on Ti were examined: (1) in auto-passivation in 5% HCl, 5% H<sub>2</sub>SO<sub>4</sub>, 6% HNO<sub>3</sub>, 1 N NaCl, 1 N NaOH at room temperature; (2) in anodic oxidation in 40% H<sub>2</sub>SO<sub>4</sub> at the

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S/020/61/141/004/014/019  
B101/B110

Examination of structure of...

potentials -0.05, +1, and +8 v; (3) in oxidation in boiling 65%  $\text{HNO}_3$ . It was found: (A) Orientation of the metal layer due to polishing of the surface causes an orientation of the crystals of the oxide film; (B) All diffraction patterns of the oxide films obtained by the solutions mentioned under (1) and (2) for -0.05 and +1 v agreed best with the diffraction pattern of titanium oxide having the composition  $\text{Ti}_2\text{O}_3 \cdot (3-4)\text{TiO}_2$ ; (C) In the case of (2) at +8 v, and in the case of (3), the oxide film consists of  $\text{TiO}_2$  having an anatase structure which contains a small quantity of rutile. Electron diffraction patterns obtained by reflection agreed with the transmission electron diffraction patterns. This confirms that removing the film from the titanium surface did not cause a structural change. Conclusion:  $\text{TiO}_2$  forms under rigorous oxidation conditions. Under milder conditions (auto-passivation at room temperature, anodic oxidation at a positive potential not being too high), the lower oxide,  $\text{Ti}_2\text{O}_3 \cdot (3-4)\text{TiO}_2$ , forms. Under conditions being still milder, the formation of even lower titanium oxides is possible. There are 2 figures.

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Examination of structure of...

S/020/61/141/004/014/019  
B101/B110

2 tables, and 15 references: 10 Soviet-bloc and 5 non-Soviet-bloc. The two references to English-language publications read as follows: P. H. Morton, W. M. Baldwin, Trans. Am. Soc. Metals, 44, 1004 (1953); S. Ogawa, D. Watanabe, Sci. Rep. Res. Inst. Tohoku Univ., no. 2, 184 (1955).

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

PRESENTED: July 5, 1961, by V. I. Spitsyn, Academician

SUBMITTED: July 4, 1961

Card 3/3

3009

S/063/62/007/002/014/014

A057/A126

1.1800

AUTHORS:

Zalivalov, F.P., Tyukina, M.N., Tomashov, N.D.

TITLE:

Properties and microstructure of thick layers of anodic films on aluminum

PERIODICAL:

Zhurnal vsesoyuznogo khimicheskogo obshchestva imeni D.I. Mendeleeva, v. 7, no. 2, 1962, 235 - 236

TEXT:

The effect of the conditions of electrolysis in sulfuric acid on microstructure characteristics of anodic layers was demonstrated in earlier papers. The effect of the microstructure of anodic layers on their properties is investigated in the present work. Electrodes of A E 000 (AV 000) aluminum containing 99.99% Al were used and anodic oxidation was carried out in 4 N H<sub>2</sub>SO<sub>4</sub>, according to a method of the present institute. These conditions allowed the preparation of layers with different, but exactly defined structures. It was observed that an increase of the oxide cell of structure (distance between two parallel planes of the cell, which increases with current density) also increases the micro-hardness and strength of the anodic layer. Thus with an increase of aluminum oxide cell from 280 Å to 547 Å micro-hardness increased from 350 to 600 kg/mm<sup>2</sup>.

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Properties and microstructure....

S/063/62/007/002/014/014  
A057/A126

Since the diameter of the pores remains constant and the increase of the cell is effected by an increase of the thickness of the walls, the rise in micro-hardness and endurance is easily to explain. Therefore, in the manufacture of anodic coatings with high mechanical properties, electrolytic conditions must be applied which allow formation of coarse structure cells. No protection can be effected by the aluminum oxide layer in media which dissolve the oxide. In these media the layer between metal and oxide film protects the metal. The thickness of this barrier layer was determined by a method described by N. Vernik and R. Pinner. Chemical resistance of the anodic layer increases with the thickness of the barrier layer, since the latter prevents the penetration of aggressive ions through pores of the aluminum oxide film. Thus an increasing of the barrier layer from 102 Å to 266 Å increases more than twice the time necessary for the penetration of aggressive ions. There are 2 figures and 4 references.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

SUBMITTED: May 14, 1961

Card 2/2

24.7700

39073  
S/080/62/035/006/008/013  
D204/D307

AUTHORS: Deryagina, O. G., Paleolog, Ye. N. and Tomashov, N.D.

TITLE: The mechanism of etching of p-n boundaries in mono-crystals of germanium

PERIODICAL: Zhurnal prikladnoy khimii, v. 35, no. 6, 1962,  
1276-1280

TEXT: Stationary potentials (E) of Ge were measured in relation to its type of conductivity and specific resistance ( $\rho$ ), to explain the mechanism of etching. The specimens of Ge were mounted in plastic, polished, etched in hot  $H_2O_2$ , and experiments were then carried out in: (I) 1 N NaOH + 0.02 N  $K_3Fe(CN)_6$ , and (II) 1.0 N NaOH + 1 N  $H_2O_2$ , in air, at room temperature. In II the stationary potentials were practically identical in the n and p regions ( $\sim -750$  mv) and were independent of  $\rho$ . In I,  $E_{(n)Ge}$  and  $E_{(p)Ge}$  va-

Card 1/2

39073  
S/080/62/035/006/008/013  
D204/D307

The mechanism of etching ...

ried by  $\sim 100$  mv ( $E_{(n)Ge}$  more negative) at  $\rho \leq 1 \Omega \cdot \text{cm}$ , and approached each other closely as  $\rho$  increased to  $10 - 20 \Omega \cdot \text{cm}$ . Studies of the (n)Ge - (p)Ge couples in I (polarization curves for (n) and (p)Ge) and microscopic observations showed that the anodic (n) regions dissolved preferentially at  $0.034 - 0.038 \text{ mg/cm}^2 \cdot \text{hr}$  (corr. current density =  $0.056 \text{ mA/cm}^2$ ). The etching was most pronounced near the boundary itself. No preferential etching was observed in II, concluding therefore that the preferential dissolution of (n) regions takes place only in solutions in which  $E_{(n)Ge} \neq E_{(p)Ge}$ . There are 2 figures and 1 table.

SUBMITTED: June 7, 1961

Card 2/2

TOMASHOV, N.D., MIKHAYLOVSKIY, YU.N., LEONOV, V.V. AND NIKITENKO, YE.A.

"Electrochemical protection of buried structures from stray current  
corrosion by means of unilaterally polarizing anodes."

Report submitted to the Second Intl. Congress on Corrosion of Metals  
New York City 11-15 March 1963

INSTITUTE OF PHYSICAL CHEMISTRY, MOSCOW

TOMASHOV, N.D., CHERNOVA, G.D., MARKOVA, O.N.,

"Effect of alloying components on the susceptibility of  
chrome-nickel steel to pitting corrosion."

Report submitted to the Second Intl. Congress on Corrosion of Metals  
New York City 11-15 March 1963<sup>c</sup>

INSTITUTE OF PHYSICAL CHEMISTRY, MOSCOW

S/030/63/000/001/007/013  
B117/B186

AUTHOR: Tomashov, N. D., Doctor of Chemical Sciences

TITLE: Symposium on corrosion and metal protection

PERIODICAL: Akademiya nauk SSSR. Vestnik, no. 1, 1963, 84 - 85


TEXT: This symposium was held in Bratislava (Czechoslovakia) on September 10 - 16, 1962. It was attended by delegates from eleven countries: Austria, Great Britain, Hungary, Eastern Germany, Poland, USSR, Finland, France, Western Germany, Czechoslovakia, Switzerland. The main work was done in three sections: Section "Theory and practice of metal protection": passivity of metals, protection against corrosion by volatile inhibitors, development of new stainless steels with reduced nickel content, protection against atmospheric influences, development of testing methods using a potentiostat, etc. The second section dealt with problems of metal protection by coatings, methods of applying coatings, automation and mechanization of these processes. The third section dealt with investigation results and progress achieved by efficiency measures in applying protective coatings to rolled products. The symposium showed the main trends in various countries in the theory and practice of metal protection. It was unanimously  
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Symposium on corrosion...

S/030/63/000/001/007/013  
B117/B186

recommended to consider the necessity for protection against corrosion in the construction of metal structures and machine assemblies. An eager exchange of opinions showed that research carried out by Soviet scientists had reached a high level, work in the field of metal protection would benefit and be accelerated by exchanging the results of investigation. The author observes that metal protection receives too little attention in the USSR.



Card 2/2

TYUKINA, M.N.; IGNATOV, N.N.; ZALIVALOV, F.P.; TOMASHOV, N.D.

Anodic oxidation of aluminum-copper alloys in sulfuric acid. Zhur.prikl.  
khim. 36 no.2:338-344 F '63. (MIRA 16:3)  
(Aluminum-copper alloys) (Oxidation, Electrolytic)

21039

S/598/61/000/006/029/034  
D228/D303

18.83 00

1413 1454

AUTHORS: Tomashov, N.D., and Modestova, V.N.  
TITLE: Behavior of titanium alloys on corrosion under stress  
in an acid environment  
SOURCE: Akademiya nauk SSSR. Institut metallurgii. Titan i  
yego splavy. no. 6, 1961. Metallotermiya i elektro-  
khimiya titana, 221 - 229

TEXT: The authors studied the behavior of tempered sheet-like material with an  $\alpha$ -structure -- the Ti-Al alloy BT5 (VT5) and the Ti alloy BT1 (VT1) -- during their corrosion under stress by acids. A problem that has also been examined by other scientists. The tests were conducted in 5.3 - 70 % solutions of HCl and H<sub>2</sub>SO<sub>4</sub>; a constant tensile-stress of up to 72 kg/mm<sup>2</sup> was applied by a leverage machine in accordance with the method of N.D. Tomashov et al (Ref. 10: Tr. Inst. fiz. khim. AN SSSR, vyp. 7, 5, 64, 1959). During the experiments the solution temperature was initially maintained at 35° before being lowered to 20°. Prior to their polishing and etching

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Z1039  
S/598/61/000/006/029/034  
D228/D303

Behavior of titanium alloys on ...

some specimens were galvanically coated with Ni to remove any surface layers of hydrides that tend to form at the section edges. The data disclose that hydrogen penetrates deep into both alloys; hydride deposition is very evident in the alloy VT5, chiefly along the gliding planes and partly in a direction normal to that of the externally-applied stress. In contrast to the alloy VT1 the VT5 specimens disintegrate with relative brittleness in dilute acid, and their rupture occurs after 35 days. Fissures are developed principally along the gliding planes, preserving on a large scale a direction normal to the stress. This behavior of the alloy VT5 may be caused by the presence of Al (4.7 %). The tendency for specimens to become passive after immersion in 5.3 % HCl for one month may result from the accumulation of  $TiCl_4$  ions in the solution, as has been noted by V.V. Andreyeva et al (Ref. 13; Dokl. AN SSSR, 128, 4, 748, 1959). For VT5 the corrosion-rate of the specimens increases with increasing acidity -- it reaches 58 g/m<sup>2</sup> per day in 40 % H<sub>2</sub>SO<sub>4</sub> -- and stress, which leads to their plastic rupture with almost the same weight-losses. The authors believe this to be due (a) to the smaller amount of absorbed hydrogen at the moment of rupture in so-

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Behavior of titanium alloys on ...

21037  
S/598/61/000/006/029/034  
D228/D303

lutions with a high corrosion-rate or on the superimposition of large stresses, and (b) to the fact that in such solutions the specimens rupture in a comparatively short time owing to their rapid deformation. The fissures caused by the formation of hydrides are of little consequence in the pre-rupture period. On corrosion under stress welded specimens of both alloys disintegrate 1.5 - 4 times more rapidly than is the case with unwelded specimens. There are 7 figures, 1 table and 13 references: 3 Soviet-bloc and 10 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: R.D.W. Strough et al, Battle Memorial Inst., Titanium Met. Lab., Columbus 15, 54, 1957; R. Meredith et al, Welding J. 36, 9, 415, 1957; G.R. McKinsey, et al., Trans. Amer. Soc. for Metals 50, 438, 1958; Thien-Shin Liu et al., Ibid. 50, 455, 1958. X

Card 3/3

18.8300

1454 1416 1413

32330  
S/081/61/000/024/040/086  
B117/B147

AUTHORS: Vedeneyeva, M. A., Tomashov, N. D.

TITLE: Corrosion of 1X18H9 (1Kh18N9) steel in sulfuric acid solution of  $\text{CuSO}_4$

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 24, 1961, 307-308, abstract 24I209 (Sb. "Korroziya i zashchita konstrukts. metallich. materialov". M., Mashgiz, 1961, 108-115)

TEXT: The corrosive action of  $\text{H}_2\text{SO}_4$  and  $\text{CuSO}_4$  on Cr-Ni austenitic steel was examined in a number of solutions with different concentrations of  $\text{H}_2\text{SO}_4$  (1, 5, 10, 15, and 20%) and  $\text{CuSO}_4$  (0, 1, 5, 10, 15, and 20%). At all concentrations, no intercrystalline corrosion was observed in boiling  $\text{H}_2\text{SO}_4$ . The uniform corrosion rises with an increase of concentration. An addition of  $\text{CuSO}_4$  sharply reduces uniform corrosion and produces intercrystalline corrosion. This is attributable to the fact that the separating contact copper, being an effective cathode, increases the anodic

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32330

S/081/61/000/024/040/086  
B117/B147

Corrosion of 1X18H9 ...

polarization of the steel, thus leading to anodic passivity. The aggressiveness of the solution rises with an increase of acid concentration. Intercrystalline corrosion is observable in 5 and 10%  $H_2SO_4$  at any  $CuSO_4$  concentration from 1 to 20%. 1%  $CuSO_4$  is sufficient to develop granular passivity. The latter is, however, no more ensured by 20%  $CuSO_4$ , although a slight intercrystalline destruction is observable only after a 103-hr test in 5% acid with 15 and 20%  $CuSO_4$ . An intercrystalline destruction depth of the order of 0.03 mm can be reached by keeping the steel sample in a boiling 10%  $CuSO_4$  solution with 20%  $H_2SO_4$  for 6 minutes, with 15%  $H_2SO_4$  for 10.5 minutes, with 10%  $H_2SO_4$  for 1.3 hr, and with 5%  $H_2SO_4$  for 103 hr. No intercrystalline corrosion was, however, observed within 100 hr in a solution of 10%  $CuSO_4$  and 1%  $H_2SO_4$ . The grain boundaries are chiefly corroded at a potential that is sufficient for passivating the grain but not for passivating the boundary. The most intense intercrystalline corrosion is observable in solutions with a steel

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S/081/61/000/024/040/086

B117/B147

Corrosion of 1X18H9 ...

potential not higher than 600 mv. To find out the tendency of steel toward intercrystalline corrosion, solutions of varying aggressiveness can be chosen by changing the content of  $H_2SO_4$  and  $CuSO_4$  according to the purpose of the investigation. An increase of the  $CuSO_4$  content reduces the aggressiveness of the solution, whereby the time elapsing up to intercrystalline destruction is prolonged. An increase of the  $H_2SO_4$  content increases the rate of intercrystalline corrosion. At an increase of the  $H_2SO_4$  concentration  $> 10\%$ ,  $CuSO_4$  additions of less than  $5\%$  should not be used to prevent uniform corrosion. The occurrence of intercrystalline corrosion can be speeded up by about 5 times by etching the samples, and not polishing them with emery paper, before the test. [Abstracter's note: Complete translation.]

Card 3/3



80190

3/020/60/132/02/46/067  
B004/B007

18.8300

AUTHORS: Tomashov, N. D., Isayev, N. I.

TITLE: Investigation of Anodic Processes in the Crack Formation in Metals  
Caused by Corrosion

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 132, No. 2, pp. 409-412

TEXT: The authors investigated the electrical factors of crack formation in metals caused by corrosion in the alloy MA2-1 (4.5% Al, 1.1% Zn, 0.6% Mn, rest Mg). The samples were subjected to a stress of 15 kg/mm<sup>2</sup> and corroded in a solution of 20 g/l K<sub>2</sub>CrO<sub>4</sub> + 35 g/l NaCl. An impulse polarization was carried out with an electric current of rectangular amplitude (0-0.5 ma/cm<sup>2</sup>) and the potential was measured by means of a loop oscilloscope. The potential in the crack formed was measured by means of a glass capillary with an internal diameter of 3-5 μ. Fig. 1 shows that the anodic polarization of the alloy (with continuous variation of amperage) amounts to 5800 v·cm<sup>2</sup>/a in non-stressed state, whereas it attains only 450-500 v·cm<sup>2</sup>/a in stressed state. Already herefrom it may be concluded that the development of the corrosion crack is due to

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80420

S/020/60/132/02/46/067  
B004/B007

**Investigation of Anodic Processes in the Crack  
Formation in Metals Caused by Corrosion**

the reduction of anodic polarizability. Concerning impulse polarization an equation is derived for the potential drop  $\Delta E_r$  after switching off of the polarization current  $i_0$ . Fig. 2 shows that the discharge curve can be reproduced by the equation for the discharge of a capacitor, which is shunted by means of a resistor. Fig. 3 shows the change of anodic polarizability in the course of development of the corrosion crack. By means of a microscope a vigorous separation of hydrogen was observed at the deepest point of the crack, whereas on the sides of the crack no hydrogen was formed. On the basis of experimental data, the authors arrive at the conclusion that the rapid development of the corrosion crack was caused by the sudden intensive decrease of anodic polarization (up to six orders of magnitude) in the zone of crack formation. Here, not the entire crack, but a limited region in its deepest point served as anode. The authors refer to papers by A. V. Ryabchenkov et al. (Refs. 3, 4) and P. A. Rebinder et al. (Refs. 5, 6). There are 3 figures and 8 references, 6 of which are Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of  
Physical Chemistry of the Academy of Sciences, USSR)

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Investigation of Anodic Processes in the Crack  
Formation in Metals Caused by Corrosion

0170

S/020/60/132/02/46/067  
B004/B007

PRESENTED: January 22, 1960, by A. N. Frumkin, Academician

SUBMITTED: January 14, 1960

Card 3/3

84631

S/076/60/034/010/012/022  
B015/B064

18.8310 2808, 1530, 1454

AUTHORS: Tomashov, N. D. and Al'tovskiy, R. M.

TITLE: Investigations of the Mechanism of Electrochemical Corrosion of Titanium. II. Corrosion and Passivity of Titanium in Hydrochloric Acid Solutions in the Presence of Platinum, Copper, and Iron Ions

PERIODICAL: Zhurnal fizicheskoy khimii, 1960, Vol. 34, No. 10, pp. 2268-2274

TEXT: The passivating action of  $Pt^{4+}$ -,  $Cu^{2+}$ -, and  $Fe^{3+}$  ions upon other metals, e.g., stainless steel and titanium has previously been studied by various researchers, among them by D. G. Monipenni, B. P. Artamonov, A. I. Shultin, G. P. Maytak, N. I. Gratsianskiy, G. P. Chernova and N. D. Tomashov, D. Shleyn and D. Smatko. The electrode potential shifts, when these ions are added, to more positive values. Uhlig and Geary (Ref. 9) assumed that  $Cu^{2+}$  and  $Fe^{3+}$  adsorb on the titanium surface, take up electrons and form dipoles whose negative end dips into the solution,

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Investigations of the Mechanism of Electro-chemical Corrosion of Titanium. II. Corrosion and Passivity of Titanium in Hydrochloric Acid Solutions in the Presence of Platinum, Copper, and Iron Ions

S/076/60/034/010/012/022  
B015/B064

so that passivation is due to a saturation of the valence forces of the surface atoms of the metal. The present paper investigates the influence of the  $Pt^{4+}$ -,  $Cu^{2+}$ -, and  $Fe^{3+}$  ions on the electrochemical and corrosion behavior of titanium in a 15% hydrochloric acid solution at 25°C. BT-IA (VT-ID) titanium was used (0.13-0.15% oxygen, 0.015% hydrogen, 0.024% nitrogen, 0.12% iron, 0.03% silicon). The admixtures were added in the form of  $H_2PtCl_6 \cdot 6H_2O$ ,  $CuCl_2 \cdot 2H_2O$  or  $FeCl_3 \cdot 6H_2O$ . The experiments were made in closed vessels, and the rate of corrosion was determined from the weight loss of the sample. Table 1 gives the results obtained, showing that in the case of small amounts of admixtures, corrosion is accelerated, i.e., most by  $Pt^{4+}$ , less by  $Cu^{2+}$ , and least by  $Fe^{3+}$ . An increase in admixture leads to the passivation of titanium with an efficiency decreasing from  $Pt^{4+}$  over  $Cu^{2+}$  to  $Fe^{3+}$ . Anodic polarization (Fig. 1) also leads to a transition from the active to the passive state. From the curves of

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B015/B064

Investigations of the Mechanism of Electro-chemical Corrosion of Titanium. II. Corrosion and Passivity of Titanium in Hydrochloric Acid Solutions in the Presence of Platinum, Copper, and Iron Ions

cathodic polarization it may be seen (Fig. 2) that in the presence of the cations added, the polarization curves reach essentially more positive potentials up to the limiting diffusion current than the curves in pure hydrochloric acid. Measurements of the constant potential after a purification of the titanium surface in the solution showed that only if the  $Pt^{4+}$ -ion concentration is increased to  $3 \cdot 10^{-6}$  g.ion/l in 15% HCl, titanium remains in passivated state after the purification of the surface. For iron ions, spontaneous passivation is only reached at a concentration of  $Fe^{3+} 1 \cdot 10^{-3}$  g.ion/l. The results show that the  $Pt^{4+}$ -,  $Cu^{2+}$ -, and  $Fe^{3+}$  ions are anodic inhibitors, which due to the acceleration of the cathodic process (Fig. 2) effect an anodic passivation of the metal surface (Fig. 1). The action of the  $Pt^{4+}$ - and  $Cu^{2+}$  ions may take place in two directions - on the one hand, as cathodic depolarizers, on the other hand, they form affective cathodic areas thus, accelerating the

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Investigations of the Mechanism of Electro-chemical Corrosion of Titanium. II. Corrosion and Passivity of Titanium in Hydrochloric Acid Solutions in the Presence of Platinum, Copper, and Iron Ions

S/076/60/034/010/012/022  
B015/B064

cathodic process. The  $\text{Fe}^{3+}$ -ions accelerate the cathodic process only as depolarizers. By a similar mechanism it is possible that other noble metals such as  $\text{Pt}^{4+}$  and  $\text{Cu}^{2+}$  bring about the titanium passivation as well as ions with variable valence (e.g. Sn, Pb etc) in a similar way as the  $\text{Fe}^{3+}$ -ions. V. I. Layner and N. G. Kudryavtseva are mentioned in the text. There are 3 figures, 1 table, and 14 references: 10 Soviet, 1 US, and 1 German. X

ASSOCIATION: Akademiya nauk SSSR Institut fizicheskoy khimii (Academy of Sciences USSR, Institute of Physical Chemistry)

SUBMITTED: January 21, 1959

Card 4/6

S/148/60/000/011/015/015  
A161/A030

AUTHORS: Tomashov, N. D.; Strekalov, P. V.

TITLE: The corrosion rate of iron-carbon alloys in acids

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya,  
no. 11, 1960, 143 - 48

TEXT: As is known, the corrosion of iron in an acid medium is mainly determined by hydrogen depolarization and depends to a high degree on the number of microcathodes and the value of hydrogen overvoltage on them. Such cathodes are in the first place the cementite with its more positive stationary potential than that of ferrite, and graphite. Besides, some slag inclusions also form cathodes as they are positive in respect to a-solid iron solution. Detailed data on the behaviour of carbon steel in acids is of practical interest - e.g., for evaluating the corrosion losses of various steels in pickling, for determining the permissible acid concentrations for storage and transportation in ferrous containers, and the like. The purpose of the present work was to obtain numerical data on the behaviour of carbon steel in nitric, sulfuric and hydrochloric acid. ✓

Card 1



The corrosion rate of iron-carbon ....

S/148/60/G00/011/015/015  
A161/A030

Five common carbon steel grades of the "Serp i molot" plant each with a different carbon content (0.025, 0.1, 0.3, 0.45, and 1.0% C) and cast iron with 3.28 % C were studied. The steel was preliminarily annealed at 900°C for 1.5 hour; specimens were tested in a thermostat at 25°. The test time was from a few minutes in undiluted acid to 40 - 50 hours in weak sulfuric and hydrochloric acid solutions. The results are illustrated in 4 graphs. In nitric acid the corrosion rate rose rapidly with increasing acid concentration and was 1000 - 3000 g/m<sup>2</sup>h at 10 % solution, rose abruptly in the 10 - 30% interval and reached the maximum of 10,000 - 20,000 g/m<sup>2</sup>h at 30 %. The increased activity of hydrogen ions (i.e., hydrogen depolarization) and reduction of anions are the causes of the higher corrosion rate in nitric acid compared with sulfuric or hydrochloric. An increase of the C content speeded up the corrosion in nitric acid only up to a certain limit, from which the corrosion rate decreased (Figure 1), which is explained by passivation through accumulation of active cathode components on the surface (carbides, graphite, slag inclusions). Analogous correlations were found in sulfuric acid (Figure 2), but the corrosion rate was lower and more smooth in variation. The mechanism is apparently not identical with

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S/148/60/000/011/015/015  
A161/A030

The corrosion rate of iron-carbon ....

the process in nitric acid, for it is probable that the formation of sulfate or sulfide films increases protection. In hydrochloric acid the solubility of metal is slow at a low concentration, then speeds up abruptly (Figure 3) and is determined by the speed of hydrogen ions discharged. Increasing C content speeds up corrosion. The data of practical importance for the quantitative correlation of the corrosion rate K of steel and the hydrogen ions activity  $\alpha$  for each of the three acids were determined (Figure 4). The relation is expressed by straight lines, and their parallel trend shows that the dissolving of steel follows the same law, and the constant  $n$  (tangent of the straight lines incline angle) does not depend on the C content in alloys. The analytical dependence of the dissolving rate of carbon steel fits the formula usually employed in literature (Ref. 4: S. A. Balezin, T. A. Krasovitskaya, Zhurnal prikladnoy khimii, 1951, no. 24, 127):

$$K = k \cdot \alpha^n$$

(K - metal dissolving rate,  $\alpha$  - acid activity,  $k$  and  $n$  - constants). The constant  $k$  presents the corrosion rate of metal at acid activity equal a unit; the constant  $n$  is determined by the nature of the acid. According

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The corrosion rate of iron-carbon ....

S/148/60/000/011/015/015  
A161/A030

to data obtained in these experiments,  $n$  is 0.875 for nitric acid, 0.90 for hydrochloric, and 0.33 for sulfuric acid. Knowing the empirical  $k$  constant (that depends on the nature of the acid and the composition of the alloy and is determined by the lengths cut off by the straight  $\lg K - \lg a$  lines from the ordinate) and the determined  $n$  constant values, the corrosion losses may be roughly calculated for carbon steel in non oxidizing acids. In the case of oxidizing acids this will only be possible for acid concentrations up to the maximum on the curves (Figure 2 and 4), i.e., as long as the corrosion rate increase is still exponential. There are 4 figures and 4 references: 3 Soviet and 1 non-Soviet. ✓

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: February 11, 1960

Card 4/8

29420

S/081/61/000/017/058/166  
B110/B138

18.8300

AUTHORS: Tomashov, N. D., Mikhaylovskiy, Yu. N., Leonov, V. V.

TITLE: Study of the action of macrocorrosion pairs formed when a metal surface is partially protected by thin protective films

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 17, 1961, 293, abstract 174218 (Tr. In-ta fiz. khimii. AN SSSR, no. 8, 1960, 305 - 312)

TEXT: The authors investigated the effect of macrocorrosion pairs on protected and unprotected metals immersed in an electrolyte consisting of 0.5 N NaCl, 0.016 N H<sub>2</sub>O<sub>2</sub> and 0.01 N HCl at ~20°C. Protective materials

used were: asphalt, paraffin, wax, bakelite varnish, nitrocellulose, drying oil, whit with drying oil and minium with drying oil. The protective films (PF) were 1.0 - 6.0 $\mu$  thick. Irrespective of the type of the PF an insulated electrode in couple with an uninsulated one always acts as the cathode. The corrosion current of the pair increases in the order Cu-Al-Fe-Zn. The presence of an incomplete PF on the metal surface leads to an improvement in the static potential of the electrode.  
Card 1/2

Study of the action of macrocorrosion...

29/420  
S/081/61/000/017/058/166  
B110/B138

and the strong localization of corrosion in the pores and places where the protective film is broken. The resistance of the PF is not only dependent on the properties of the material of which it is made but also on the corrosion potential of the metal in the aggressive medium in question. [Abstracter's note: Complete translation.]

X

Card 2/2

S/137/61/000/006/085/092  
A006/A101

AUTHOR: Tomashov, N.D.

TITLE: Corrosion and protection of metals in sea water

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 6, 1961, 50, abstract 61389  
("Tr. In-ta fiz. khimii, AN SSSR", 1960, no. 8, 313 - 332)

TEXT: Factors are discussed (the geographical and biological factor, the effect of the motion speed of the water) affecting corrosion resistance of metals in sea water, which is considered as a corrosion electrolyte. Contact corrosion of various metals in sea water is studied, as well as the effect of the nature of metal contact with water, and non-uniform aeration during corrosion in sea water. The following anti-corrosion means are recommended: efficient design of marine constructions and ships; efficient technological operations during their construction and repair; improved quality of metals employed; improved quality and technology of applying protective coatings; extended use of electrochemical protection. There are 31 references.

Ye. Layner

[Abstracter's note: Complete translation]

Card 1/1

TOMASHOV, N.D.; MIKHAYLOVSKIY, Yu.N.

Electrical method of determining the rate of penetration of an  
electrolyte through protective films. Trudy Inst.fiz.khim. 8:249-  
253 '60. (MIRA 14:4)

(Electrolytic corrosion--Testing)  
(Electric testing)

TOMASHOV, N.D.; LUNEV, A.F.; MIKHAYLOVSKIY, Yu.N.; LEONOV, V.V.

Determination of protective properties of metal coatings. Trudy  
Inst.fiz.khim. 8:235-248 '60. (MIRA 14:4)

(Protective coatings)



TOMASHOV, N.D.; BERUKSHTIS, G.K.

Determining the rate of atmospheric metal corrosion by meteorological characteristics. Trudy Inst.fiz.khim. 8:69-83 '60. (MIRA 14:4)

(Corrosion and anticorrosives--Climatic factors)

TOMASHOV, N.D.

Theory of atmospheric metal corrosion. Trudy Inst.fiz.khim. 8:14-40  
:60. (MIRA 14:4)

(Corrosion and anticorrosives)

*Tomashov, N. D.*

81931  
S/062/60/000/06/02/011  
B020/B061

188300

AUTHORS: Mirolubov, Ye. N., Kurtegov, M. M., Tomashov, N. D.

TITLE: The Study of the Corrosion and Electrochemical Behavior of Stainless Steels by Cathodic Polarization in Nitric Acid Solutions. I. The Characteristics of the Self-dissolution of Steels

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1960, No. 6, pp. 1015-1021

TEXT: The above investigation was carried out by the authors so that they could subsequently examine the processes in stable, passive state, on its disturbance, and in active state on stainless steels. The possibility of the disturbance of the passive state and the successive formation of a cathodic electrochemical protective effect under the conditions examined, has previously been shown by the authors (Ref. 4). The disturbance of the passive state of stainless steels and their obtention in active state in nitric acid solutions were effected out with the aid of cathodic polariza- *XX*

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The Study of the Corrosion- and Electrochemical  
 Behavior of Stainless Steels by Cathodic  
 Polarization in Nitric Acid Solutions. I. The  
 Characteristics of the Self-dissolution of Steels

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S062/60/000/06/02/011

B020/B061

tion with an external current source. The determination of the relationship between the rate of corrosion and the potential and the cathodic polarization curves received the most attention. These dependences were obtained with the aid of the polarization of the samples by current with known intensity, adapted to each sample. The dependence of the rate of corrosion, calculated on the basis of the loss in weight, and the density of the polarization current on the potential, was determined on the basis of the established loss in weight of the steel samples and the average values of the potential during the test with each given polarization current density. These dependences represent the anodic and cathodic polarization curves. All potential values are converted to the hydrogen scale, with consideration of the diffusion potentials. Known stainless structural steels were used as test pieces in the shape of cylindrical samples. The chemical composition and the structure of the steels corresponded to the standard ГОСТ-5632-50 (GOST 5632-50). Fig. 1 gives a typical dependence between the rate of corrosion of stainless steels on cathodic polarization

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The Study of the Corrosion- and Electrochemical Behavior of Stainless Steels by Cathodic Polarization in Nitric Acid Solutions. I. The Characteristics of the Self-dissolution of Steels

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B020/B061

in nitric acid solutions and the potential. Fig. 2 shows the dependence of the rate of corrosion of the steel 1X18H11B (1Kh18N11B) on the potential in nitric acid solution at 20°, Fig. 3, the dependence of the rate of corrosion of the stainless steel 1Kh18N11B, polarized to a certain potential, on the concentration of nitric acid at 20°, Fig. 4, the dependence of the active participation of the surface of the steel 1Kh18N11B at a potential of -0.1 v at 20° on the concentration of nitric acid, Fig. 5, the dependence of the anodic polarizability of the steel 1Kh18N11B in active state on the concentration of nitric acid at 20°, Fig. 6, the dependence of the rate of corrosion of iron and the steel 1X13 (1Kh13) on the potential in 3% nitric and sulfuric acid solutions, and Fig. 7 the dependence of the rate of corrosion of the steel 1Kh18N11B on the potential in 3% nitric acid at various temperatures. The temperature coefficients of the rate of corrosion of the steel 1Kh18N11B in 3% HNO<sub>3</sub> at various potentials (Table 1), and at  $\varphi = 0.1$  v in nitric acid solutions (Table 2), are given. The self-dissolution process of

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S/062/60/000/06/02/011  
B020/B061  
The Study of the Corrosion- and Electrochemical  
Behavior of Stainless Steels by Cathodic  
Polarization in Nitric Acid Solutions. I. The  
Characteristics of the Self-dissolution of Steels

stainless steels on cathodic polarization is decelerated by the diffusion  
due to slower feeding of the acid to the surface of the steel. There are  
7 figures, 2 tables, and 14 references: 10 Soviet, 1 British and 3 German. //

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of  
Physical Chemistry of the Academy of Sciences USSR)

SUBMITTED: December 24, 1958

Card 4/4

*Tomashov, N.D.*

82445

S/149/60/000/004/009/009

*18.1200*

AUTHORS: Babkin, Yu.A., Tomashov, N.D., Titov, V.A., Konstantinov, V.I.  
 TITLE: Corrosion Resistance of Tantalum-Niobium Alloys in Sulfurous Acid  
 PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Tsvetnaya metallurgiya,  
1960, No. 4, pp. 153-156

TEXT: The authors investigated the corrosion resistance of tantalum-niobium alloys in sulfurous acid at various temperatures. The alloys were prepared of electrolytic powders by the metalloceramic method and subsequently rolled into sheets. Specimens were cut out of the unannealed sheets. The tests were performed with specimens of pure tantalum and niobium and their alloys with a Ta content of 21.6; 34; 48.9; 51.1; 67.3 and 70.8 atomic %. The amount of admixture in the alloys did not exceed 0.1%. Prior to the tests the specimens were polished, washed and degreased. Corrosion tests were performed at 20 and 60°C with flasks with ground stoppers. At 110 and 150°C the experiments were carried out with soldered glass ampoules placed in metal cylinders with screwed-on stoppers. To prevent the destruction of ampoules by internal pressure, the cylinders were filled with water whose vapors produced the necessary counter-pressure. The flasks and cylinders were kept in a thermostat for 20 hours. During the tests, measurements

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82445

S/149/60/000/004/009/009

# Corrosion Resistance of Tantalum-Niobium Alloys in Sulfurous Acid

were taken of the corrosion rate (in  $\text{g/m}^2 \text{ hr}$ ); proneness to crystallite corrosion; changes in the mechanical properties, and electrode potential. The irreversible electrode potential was measured every 5-10 minutes during 3-4 hours by the conventional potentiometric circuit. A calomel electrode served as a comparison electrode. The following results were obtained: Corrosion of pure niobium and niobium alloys with 21.6; 34 and 48.9 atomic % Ta was observed in 90%  $\text{H}_2\text{SO}_4$  at  $110^\circ\text{C}$ . An increased Ta content made the alloys corrosion resistant in the same degree as pure Ta. Proneness to crystallite corrosion was not observed. During the corrosion process changes in the mechanical properties of niobium and the alloy with 21.6% Ta took place as a result of hydrogenization. In 90%  $\text{H}_2\text{SO}_4$  at  $60^\circ\text{C}$ , niobium corrosion depended linearly on the holding time at a mean rate of  $0.354 \text{ g/m}^2 \cdot \text{hour}$ . The niobium alloy with 21.6% Ta corroded noticeably after 100 hrs. Maximum hydrogenization of niobium at  $110^\circ\text{C}$  was observed in 60%  $\text{H}_2\text{SO}_4$ . Niobium and its alloy with 21.6% Ta corroded, depending on the temperature, according to the exponential equation

$$K = A e^{-\frac{Q}{RT}},$$

where A is the constant; Q is the activation energy of the process in cal/mole;

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S/149/60/000/004/009/009

Corrosion Resistance of Tantalum-Niobium Alloys in Sulfurous Acid

R is the gas constant, and T is the temperature in K scale. The activation energy of niobium is 5440 cal/mole and 15,000 cal/mole for the alloy. It was established that Ta-Nb alloys, beginning with a Ta content of over 30%, were almost fully corrosion resistant in 90% H<sub>2</sub>SO<sub>4</sub> at 110°C. This approaches the resistance of pure Ta. The alloys can be recommended to be used as structural and coating materials for equipment and structures operating under similar conditions. There are 4 graphs, 1 photo and 4 Soviet references. ✓

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute) Kafedra korrozii i zashchity metallov (Department of Corrosion and Protection of Metals)

SUBMITTED: August 20, 1959

Card 3/3

S/184/60/000/004/007/021  
A109/A029

AUTHORS: Tomashov, N.D., Professor, Doctor of Chemistry; Shreyder, A.V.,  
Docent, Candidate of Technical Sciences; Titov, V.A., Candidate of  
Technical Sciences

TITLE: Investigation of Corrosion Resistance of Metals in Solutions of Sul-  
furic and Phosphoric Acids at High Temperatures

PERIODICAL: Khimicheskoye Mashinostroyeniye, 1960, No. 4, pp. 20 - 24

TEXT: This article was worked out in cooperation with I.M. Balandin, V.M.  
Dobrov, L.Ya. Suvorov, Doctor of Chemistry A.I. Krasil'shchikov, and Candidates  
of Technical Sciences A.A. Babakov, A.Ye. Gopius and V.I. Konstantinov and gives  
results of tests on machine building materials. The resistance in diluted sul-  
furic and phosphoric acids, the technological and physical properties of the fol-  
lowing metals and alloys were investigated: OX18H9T (OKh18N9T), 1X18H9T (IKh18N9T),  
X28 (Kh28), X34 (Kh34), ЭИ380 (EI380), ЭИ530 (EI530), ЭИ432 (EI432), ЭИ533 (EI-  
533), ЭИ628 (EI628), ЭИ629 (EI629), ЭИ349 (EI349), Бр. АН 7-8 (Br. AN 7-8), Бр.  
АМ4. 9-2 (Br. AMts. 9-2), Бр. АЖ 9-4 (Br. AZh. 9-4) alloys, platinum plate, zir-  
conium, tantalum, niobium and other materials. Tests were carried out in sealed

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S/184/60/000/004/007/021

A109/A029

Investigation of Corrosion Resistance of Metals in Solutions of Sulfuric and Phosphoric Acids at High Temperatures

pyrex glass and ampoules placed in an autoclave of 1Kh18N9T steel. Temperatures varied from 250 - 300°C and the heating time from 24 - 1,501 h. Complications arose during tests of materials with low corrosion resistance as nascent hydrogen caused inner pressure, occasionally resulting in bursting of the ampoule. A detailed description of the test methods and conditions is given. The corrosion depth in mm/year after a 72-h test demonstrates clearly the effect of temperature on the corrosion of alloys. The 72-h corrosion depth logarithm depends on the reciprocal value of the absolute temperature. At corrosion in 10%-H<sub>3</sub>PO<sub>4</sub> the phosphate layers observed on the surface of EI461 and EI629 alloys had a decisive protective character. Corrosion tests in sulfuric and phosphoric acids established a high resistance of platinum and an adequate resistance of tantalum. Niobium and its binary alloys with tantalum retain their resistance only in sulfuric acid. A low-resistance protective layer is formed on the surface of acid-proof austenitic nickel-chromium-molybdenum steel and nickel-based EI461 alloy in phosphoric acid at high temperatures. Protective coatings are formed on the surface of niobium and niobium-tantalum alloys in sulfuric and phosphoric acids. Their presence on niobium-tantalum alloys in phosphoric acid prevents the solu-

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S/184/60/000/004/007/021  
A109/A029

Investigation of Corrosion Resistance of Metals in Solutions of Sulfuric and Phosphoric Acids at High Temperatures

tion of metal, but cannot prevent brittle cracking caused by the adsorption of nascent hydrogen. Acidproof iron, nickel and copper-based metals are not suitable for building of machines operating in 3 - 10% sulfuric and phosphoric acid solutions at 250 - 300°C. The crack formation in molybdenum and zirconium is slow. Tantalum, niobium and their binary alloys can be used for machines operating in weak sulfuric acid solutions at 250 - 300°C, tantalum is recommended for operation in phosphoric acid. There are 3 figures, 2 tables and 13 references: 2 English, 5 German and 6 Soviet. ✓

Card 3/3

TOMASHOV, N.D.; BYALOBZHESKIY, A.V.; IGNATOV, N.N.; VAL'KOV, V.D.

Weakly corrosive electrolytes for anodization of large surfaces  
and parts with complex configurations. Zhur. prikl. khim. 34  
no.5:1072-1077 My '61. (MIRA 16:8)

(Protective coatings) (Electrolytes)

MIKHAYLOVSKIY, Yu.N.; NIKITENKO, Ye.A.; LEONOV, V.V.; TOMASHOV, N.D.

Electrochemical protection of gas pipelines from corrosion  
caused by stray currents. Gaz. prom. 7 no.9:37-42 '62.  
(MIRA 17:8)

TOMASHOV, N.D., doktor khim. nauk, prof., otv. red.; GOLUBEV, A.I.,  
doktor tekhn. nauk, otv. red.; PALEOLOG, Ye.N., kand. khim.  
nauk, red.; AL'TOVSKIY, R.M., kand. khim. nauk, red.;  
MIROLYUBOV, Ye.N., kand. khim. nauk, red.; ARKHANGEL'SKAYA,  
M.S., red.; ISLENT'YEVA, P.G., tekhn. red.

[Corrosion of metals and alloys] Korroziia metallov i splavov;  
sbornik. Moskva, Metallurgizdat, 1963. 382 p. (MIRA 16:5)  
(Corrosion and anticorrosives)

TOMASHOV, N.D.; AL'TOVSKIY, R.M.; KOLOTYRKIN, Ya.M., doktor khim.  
nauk, retsenzent; PREOBRAZHENSKIY, A.Yu., red.;  
YEVSTAF'YEVA, N.P., red. izd-va; SMIRNOVA, G.V., tekhn.red.

[Titanium corrosion and its protection] Korrozia i zashchita  
titana. Moskva, Mashgiz, 1963. 167 p. (MIRA 16:7)  
(Titanium--Corrosion)



TOMASHOV, N.D.; CHERNOVA, G.P.; AL'TOVSKIY, R.M.

Mechanism of the electrochemical corrosion of titanium. Part 3:  
Corrosion and electrochemical behavior of titanium and its  
platinum and palladium alloys in sulfuric and hydrochloric  
acid solutions. Zhur. fiz. khim. 35 no.5:1068-1077 My '61.  
(MIRA 16:7)

1. Institut fizicheskoy khimii AN SSSR.  
(Titanium alloys—Corrosion)  
(Electrochemistry)

TOMASHOV, N.D.; MIKHAYLOVSKIY, Yu.N.; LEONOV, V.V. (Moscow)

Mechanism of the electrochemical corrosion of metals under  
insulating coatings. Zhur. fiz. khim. 35 no.2:367-372 F '61.  
(MIRA 16:7)

1. Institut fizicheskoy khimii AN SSSR.  
(Electrolytic corrosion) (Protective coatings)  
(Metals)

АВТОРЫ: Санин Се́н-мин; Заливалов, Р. Р.; Томасов, Н. В.

TITLE: The effect of the temperature of an electrolyte on the properties and microstructure of thick-layer anode films

SOURCE: Zhurnal prikladnoy khimii, v. 36, no. 7, 1963, 1503-1506

TOPIC TAGS: Anodizing, thick-layer anode film, aluminum, electrolyte temperature

**ABSTRACT:** Disks of ABOO/aluminum (99.9 Al), 32 mm in diameter and 2.5 mm thick, were used in temperature tests under conditions simulating practical operations. One side of the disk was anodized, the other coated with AK-201 varnish. Before anodizing, the samples were polished, rubbed with alcohol, dipped in a 10% NaOH solution for 1 min, and clarified in a 30% HNO sub 3 solution for 3 min. Anodic oxidation was carried out in a 4 N H sub 2 SO sub 4 solution at a current density of 2.5 A/sq decimeters for 60 min, yielding a film thickness of ca. 60 micra. Electrolyte temperatures compared were -6, 0, +5, and 10C. The weight, thickness, and hardness of the thick-layer anode films decreased with increasing electrolyte temperatures, but their porosity increased. Increasing the temperature also affected the microstructure of the films, increasing the number of nuclei of

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L 17760-63

ACCESSION NR: AP3006181

oxidation and hence pores by decreasing their transverse dimensions. Film properties were also affected by the anodizing conditions (type of heat emission). Films obtained during the circulation of sulfuric acid had the best properties: minimal porosity (5.5%) and maximal hardness (560 kg/sq. mm). Orig. art. has: 4 figures, 1 table.

ASSOCIATION: None

SUBMITTED: 22Jan62

DATE ACQ: 25Sep63

ENCL: 00

SUB CODE: CH

NO REF SOV: 006

OTHER: 000

2/2

Card

TOMASHOV, N.D.

"Passivity and Corrosion Resistance of Metal Systems."

Report presented at the 14th meeting CITCE, Intl. Comm. of Electrochemical Thermodynamics and Kinetics, Moscow, 19-25 Aug 63.

Institute of Physical Chemistry, Academy of Sciences of U.S.S.R., Moscow.

L 12418-63

ENP(q)/EWT(m)/BDS AFFTC/ASD JD/WB

ACCESSION NR: AP3001412

S/0020/63/150/004/0852/0855

AUTHOR: Tomashov, N. D.; Strulov, N. M.; Mikhaylovskiy, Yu. N.

TITLE: The effect of alternating current frequency on the speed of corrosion of titanium in sulfuric acid

SOURCE: AN SSSR. Doklady, v. 150, no. 4, 1963, 852-855

TOPIC TAGS: electrochemical properties of titanium, corrosion properties of titanium, polarization of titanium, titanium

ABSTRACT: The investigation of the electrochemical and corrosion behavior of titanium during its polarization with a sinusoidal variable current frequency showed that, with an increase of frequency of the polarizing current, the polarizing capability of the electrode in the anodic and in the cathodic half-period is decreased. This is additionally connected with the presence of current capacity and the explanation of easier electrochemical reactions on the surface of the electrode in the anodic and cathodic half-periods. The corrosion of titanium at lower frequencies and low densities of the polarizing current is greater than the corrosion at higher frequencies. However, a reverse effect is observed with very high densities of the polarizing current. The

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examination of experimenting material shows that the variable current intensifies the process of anodic dissolution of titanium as a result of the destruction of the passive state of the electrode in the cathodic half-period. It appears that at high frequencies of the variable current in the anodic half-period when the surface of metal contains mainly the adsorbed oxygen, the activation of metal in the cathodic half-period is much greater, and thus, the dissolution of titanium is greater. At low frequencies the metal surface is covered mainly with the chemically bound oxygen in the form of oxide layers which is not completely reduced in the cathodic half-period and therefore the active surface of the metal is smaller and the speed of dissolution of the metal is smaller. Orig. art. has: 5 graphs.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences SSSR)

SUBMITTED: 29Jan63

DATE ACQ: 01Jul63

ENCL: 00

SUB CODE: 00

NO REF SOV: 003

OTHER: 000

Card 2/2

TOMASHOV, N.D.; STRUKOV, N.M. .

Effect of the alternating current frequency on the passivation of titanium. Dokl. AN SSSR 152 no.5:1177-1180 O '63. (MIRA 16:12)

1. Institut fizicheskoy khimii AN SSSR. Predstavleno akademikom A.N.Frumkinyn.



TOPIC TAGS: corrosion protection, underground equipment, electrochemical process, electric drainage

ABSTRACT: The present invention is a method for protecting underground equipment from corrosion by providing a cathodic protection system.

It draws off the current from the underground equipment in the anode zones and pre-

Card 1/2

**"APPROVED FOR RELEASE: 04/03/2001**

**CIA-RDP86-00513R001756210009-0**

L 35589-65

**APPROVED FOR RELEASE: 04/03/2001**

**CIA-RDP86-00513R001756210009-0"**

ACCESSION NR: AT4043070

S/0000/64/000/000/0156/0166

AUTHOR: Chernova, G. P., Tomashov, N. D., Volkov, L. N.

TITLE: A study of the possible use of anodic protection of stainless steel in isobutene extraction processes

SOURCE: Mezhevuzovskaya konferentsiya po anodnoy zashchite metallov ot korrozii. 1st, Kazan, 1961. Anodnaya zashchita metallov (Anodic protection of metals); doklady\* konferentsii. Moscow, Izd-vo Mashinostroyeniye, 1964, 156-166

TOPIC TAGS: stainless steel, steel 1Kh18N9T, isobutene extraction, stainless steel corrosion, anodic corrosion protection, stainless steel passivation, steel corrosion, corrosion temperature, isobutylsulfuric acid

ABSTRACT: Stainless steel 1Kh18N9T, proposed as a reactor material for extracting isobutene from cracking gases, according to a process developed at the VNIINefte Khim, was corrosion-tested at 45C in 65% H<sub>2</sub>SO<sub>4</sub> and in isobutylsulfuric acid (a complex ester formed when an alcohol radical displaces an H atom in the H<sub>2</sub>SO<sub>4</sub> molecule). The results indicate that this material is unsuitable without anodic anticorrosion protection, its unprotected rate of corrosion depending on agitation (intensively employed in extracting

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ACCESSION NR: AT4043070

isobutene) and amounting to 2 or more mm per year. Hence, the authors studied the anodic behavior of stainless steel in these media, with and without agitation, at 25-65C. The results indicate passivation at a potential range of +0.2 to +1.25V. Current density in the passive state ranged from 5 to 10 ma/cm<sup>2</sup> and was practically independent of solution characteristics, temperature or agitation. The rate of corrosion in these media was 0.08 mm/year at 25C and +0.3 to +1.2v. In this potential range for hardened and tempered samples, there was no tendency to intercrystalline corrosion. Orig. art. has: 10 graphs and 1 table.

ASSOCIATION: None

SUBMITTED: 13Mar64

ENCL: 00

SUB CODE: FP, MM

NO REF SOV: 010

OTHER: 008

2/2

Card

can be taken as

is required for anodic

The maximum density of the film is 0.15. The maximum density of the film is 0.15.

This allows a comparison of the film to the original. This allows a comparison of the film to the original.



ACCESSION NR. AT-0-3073

S 0001 04-000/000/0100/0200

Author: Timashov, N. D.; Zaslavlov, F. P.

Subject: anodization of aluminum and its alloys

anodirovaniye kumfementalaya po zashchite metalloy ot

korrozii

TOPIC TAGS: aluminum, aluminum copper alloy, D 16 alloy, aluminum  
oxide, thick aluminum oxide film, thick oxide film structure,  
thick oxide film.

ABSTRACT Experimental investigation showed that thick oxide films  
formed on anodized aluminum and aluminum alloys consist of closely  
packed cells in the form of hexagonal prisms oriented perpendicularly  
to the metal surface and bonded along the side faces. The cells grow  
on top of a barrier layer, 100-300 Å thick, after it has formed  
on the metal surface. The thickness of the barrier layer does not

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L 10385-65

ACCESSION NR: AT4043771

Card 3.3

... best protective properties

caolab.

APPROVED FOR RELEASE

Card 1/1

...  
... VT-1 commercial  
... 07-2 '63 A1

anodizing of aluminum in sulfuric acid solution alloy anodized in sulfuric

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